# An Action Plan to Reopen a Contaminated Airport

HOW would authorities respond if San Francisco International Airport (SFO) were to be contaminated with anthrax, and how long would it take to restore the airport to full usability? An intentional bioterrorist attack at the airport could endanger the health of hundreds of people. Long-term closure of this critical transportation hub during decontamination would have disastrous effects on the regional and national economy.

Recall the events of late 2001 when letters containing anthrax spores contaminated office buildings and postal facilities in Florida, New York City, Washington, DC, and other locations. Although some buildings were back in full operation in less than a month, others took many months to reopen, and one Department of State facility was closed for three years.

With that experience in mind, the Department of Homeland Security (DHS) funded a project to minimize the time a major transportation facility would be closed following a biological attack. Lawrence Livermore and Sandia national laboratories led the project, in partnership with SFO, to develop response and restoration protocols for such events. The group's work culminated in January 2006 when 120 officials from local, state, and federal agencies participated in a two-day demonstration at SFO's old international terminal to test the new procedures.

Returning the international terminal and a boarding area at SFO to full operation from a large-scale terrorist incident may have taken up to two years based on other biorestoration activities and the decontamination and restoration methods that were available in 2001. Using the protocols developed by the Livermore–Sandia team reduces that time by at least 50 percent. In fact, the team estimates that the time required would actually be less than six months, depending on the level of planning in place prior to an attack.


In January 2006, an interagency group of emergency responders tested the response and restoration protocols developed by Lawrence Livermore and Sandia national laboratories in a two-day demonstration at San Francisco International Airport.

## Planning and Preparedness Are Key

To develop the protocols, team members worked with the public agencies that would respond to an attack at SFO or would help decontaminate the facilities. Participants included officials from SFO and other major airports, the U.S. Environmental Protection Agency (EPA), California EPA, Centers for Disease Control and Prevention (CDC), U.S. Postal Service, Department of Defense, Federal Bureau of Investigation, and National Institute for Occupational Safety and Health (NIOSH). The interagency group developed a list of activities that would be central to crisis and consequence management following a bioterrorist attack. (See the table on p. 11.)

The group then identified several areas for improvement. Perhaps most important was preincident planning and preparedness. Livermore scientist Ellen Raber notes that, before this project started, little realistic planning had been done for responding to a deliberate act of bioterrorism against a public transportation facility. However, having a restoration plan vetted and facility personnel trained substantially reduces the overall time for a restoration operation. "Planning and preparedness are keys to success, not only for the specific facility but for all public agencies that might be involved," says Raber, who leads the Response and Recovery Program in Livermore's Nonproliferation, Homeland and International Security Directorate.

Environmental scientist Tina Carlsen, who works in the Laboratory's Environmental Restoration Division, helped the team develop a generic biological restoration plan for major airports. The plan includes templates for characterizing and removing the contamination and obtaining clearance to reopen the airport. It recommends actions for emergency responders, methods for sampling and analysis, and handling procedures for decontaminated waste. The restoration plan also evaluates the decontamination methods available, including liquid, gel, and gaseous reagents. Special emphasis is given to chlorine dioxide and vaporous hydrogen peroxide, the methods that were used to clean up anthrax-contaminated facilities in 2001. The plan pulls all of this work into a framework that decision makers can use in the event of bioterrorism.

After review by CDC, regional EPA offices, NIOSH, and other agencies, the *Biological Restoration Plan for Major Airports* was submitted to DHS and EPA. These two organizations will issue the report in 2006 as a DHS–EPA guidance document that airports can use to plan recovery activities following a bioterrorist attack. The document also offers guidance on developing incident- and facility-specific restoration plans. SFO now has such a plan for an anthrax attack, thanks to its partnership in this project.

The Livermore team is working with Los Angeles International Airport to develop a site-specific data supplement to this plan. Workshops are also being held with major East Coast airports to begin transferring elements of the project to more users.

## Making a Clean Sweep

A fast, accurate sampling and analysis process is essential to shorten the time line for restoration. Surfaces and the air must be tested to determine the extent of contamination and to ensure that the facility has been decontaminated. A large building such as an airport terminal has enormous air-handling systems that would likely become contaminated by a cloud of aerosolized bioagent. The moving air in heating and cooling systems can re-aerosolize a bioagent, remobilizing it to contaminate yet more surfaces and air. Thus, a fast response is essential to limit the spread of a bioagent.

Current methods for identifying a biological agent and determining whether it is viable (alive) involve culturing a sample—a process that can take several days. To reduce the turnaround time, Sandia scientists focused on improving sampling methods and efficiency, while Livermore's task was to speed up the analysis process.

| Crisis Management | | Consequence Management | | | |
|---|---|---|---|---|---|
| Response Activities | | Restoration Activities | | | Recovery Activities |
| Notification | First Response | Characterization | Remediation/ Cleanup | Clearance | Reoccupancy |
| Receive and assess information<br><br>Identify suspect release sites<br><br>Relay key information and potential risk to appropriate agencies | HAZMAT and emergency actions<br><br>Forensic investigation<br><br>Public health actions<br><br>Screening sampling<br><br>Determine agent type, concentration, and viability<br><br>Risk communication | Detailed characterization of biological agent<br><br>Characterization of affected site<br><br>Site containment<br><br>Continue risk communication<br><br>Characterization/ environmental sampling and analysis<br><br>Initial risk assessment<br><br>Clearance goals | Decontamination strategy<br><br>Remediation action plan<br><br>Worker health and safety<br><br>Site preparation<br><br>Source reduction<br><br>Waste disposal<br><br>Decontamination of sites and/or items<br><br>Decontamination verification | Clearance sampling and analysis<br><br>Clearance decision | Renovation<br><br>Longer-term environmental and public health monitoring<br><br>Reoccupation decision |

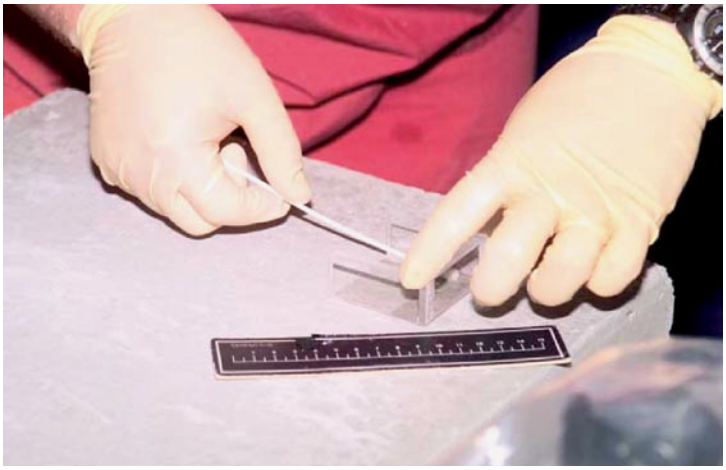
The Livermore–Sandia project identified a set of activities for restoring a contaminated facility following a bioterrorist attack.

The Livermore researchers expanded high-throughput sample analysis assays that use polymerase chain reaction (PCR). This system, called rapid viability PCR (RV-PCR), can analyze hundreds to thousands of samples per day, compared with at most 30 samples a day for the standard culturing process. RV-PCR is based on CDC–NIOSH protocols and uses commercially available automation techniques. For *Bacillus anthracis* (the causative agent for anthrax), it reduces the time to determine viability from several days to between 10 and 16 hours. The team has demonstrated similar reductions in detection time in proof-of-concept tests for *Yersinia pestis* (plague), *Brucella* (a bacteria), and *Francisella tularensis* (tularemia).

In the January demonstration, the RV-PCR data were tracked using the Building Restoration Operations Optimization Model (BROOM) developed by Sandia. BROOM software is useful for many phases of an indoor decontamination operation: planning, data collection, data management, and data analysis. The system can store thousands of facility drawings, which can be downloaded during sampling, and its barcode system eliminates manual data entry. A Web-based relational database offers remote, secure access to sampling procedures, collected data, floor plans, ventilation drawings, and other information. In addition, the software's statistical algorithms can estimate the total contamination using a limited sample set.

To help authorities determine how clean a facility must be before it can be reopened, the National Research Council (NRC) of the National Academies, with oversight by Livermore, prepared a framework for evaluating decontamination efforts. In 2005, NRC published this framework in *Reopening Public Facilities after a Biological Attack*, which recommends risk assessment actions, public health safeguards, sampling procedures, and decontamination standards. No universal standard is offered for determining when a building would be safe to reenter because the type of pathogen and the amount disseminated affect cleanup operations. The report, therefore, includes questions about pathogen characteristics—such as how far it has spread, whether it is transmissible between humans, and how long it will survive to pose a threat—to help decision makers determine the appropriate response.

Past cleanup efforts, such as those for the 2001 anthrax attacks and the EPA's Superfund Program, offered vital lessons learned. For instance, federal officials determined that response and remediation activities following the 2001 attacks were hindered because procedures or regulations prevented law-enforcement and public health agencies from sharing the data collected at contaminated sites. The NRC report encourages building owners and managers to plan responses to bioterrorism and advocates full transparency in sharing health information so that decision makers can better evaluate the risks involved in a recommended action.



Swipe samples collected from surfaces are analyzed following a biological dispersal to determine the extent of contamination. Tests are repeated following cleanup activities to verify the effectiveness of decontamination.

## Open and Shut Cases

A new DHS assignment for Livermore is to develop protocols for responding to and cleaning up a large outdoor area contaminated by a bioagent. Researchers already know that sunlight will naturally degrade many biological pathogens. Also, when some bioagent particles hit soil, they stay there, so re-aerosolization is less of a problem. Still, planning for such an attack is new territory. Says Raber, "At this point, no one has experience with wide-area urban decontamination."

The Laboratory is also developing a site-specific biological restoration plan for Grand Central Station in New York City, where Livermore's Autonomous Pathogen Detection System has been tested. (See *S&TR*, October 2004, pp. 4–5.) A major subway station offers yet another set of challenges because it is part of a web of tunnels, staircases, and large semi-contained areas. "We look forward to continuing our involvement with major transportation facilities," says Carlsen. "They are a key to our nation's economic vitality and the well-being of our citizens."

*—Katie Walter*

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